TEST REPORT

Dt&C

Dt&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea,17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2305-0064
2. Customer
   - Name (FCC) : CRAECA
   - Address (FCC) : #1406, O'biz Tower, 126, Beolmal-ro, Dongan-gu Anyang-si, Gyeonggi-do South Korea
3. Use of Report : Verification test for simultaneous transmission
4. Product Name / Model Name : 60GHz Object detection Sensor / V-PR100

   FCC ID : 2A8FDVPR100
5. FCC Regulation(s): Part 15.247, Part 15.255

   Test Method used: KDB558074 D01v05r02, ANSI C63.10-2013
6. Date of Test : 2022.11.14 ~ 2022.11.28
7. Testing Environment : Refer to appended test report.
8. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : SeungMin Gil (Signature)	Technical Manager Name : JaeJin Lee (Signature)

2023 . 05 . 03 .

Dt&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

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Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2305-0064	May, 03. 2023	Initial issue	SeungMin Gil	JaeJin Lee

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1. General Information

1.1 Description of EUT

Product Name	60GHz Object detection Sensor	
Model Name	V-PR100	
Add Model Name	-	
Power Supply	DC 5 V	
Frequency band	60GHz Radar	57 ~ 71 GHz
	Bluetooth LE	2 402 MHz ~ 2 480 MHz
Antenna Specification	60GHz Radar	Antenna type: Folded dipole antenna Gain(Max): 6.0 dBi
	Bluetooth LE	Antenna Type: SMD Antenna Gain(Max): 0.8 dBi

1.2. Declaration by the applicant / manufacturer

N/A

1.3. Testing Laboratory

Dt&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of Part 2.948 according to ANSI C63.4-2014. **- FCC & IC MRA Designation No. : KR0034** **- ISED#: 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.4. Testing Environment

Ambient Condition	
▪ Temperature	+21 ℃ ~ +25 ℃
▪ Relative Humidity	+40 % ~ +45 %

1.5. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Radiated spurious emission (1 GHz Below)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.0 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.2 dB (The confidence level is about 95 %, k = 2)

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1.6. Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	22/06/24	23/06/24	US47360812
Spectrum Analyzer	Rohde Schwarz	FSW85	21/12/16	22/12/16	101530
Multimeter	FLUKE	17B+	21/12/16	22/12/16	36390701WS
Signal Generator	Rohde Schwarz	SMBV100A	21/12/16	22/12/16	255571
Signal Generator	ANRITSU	MG3695C	21/12/16	22/12/16	173501
Thermohygrometer	XIAOMI	MHO-C201	21/12/16	22/12/16	00089675
Thermohygrometer	BODYCOM	BJ5478	21/12/16	22/12/16	120612-2
Loop Antenna	ETS-Lindgren	6502	21/01/28	23/01/28	00226186
Hybrid Antenna	Schwarzbeck	VULB 9160	21/12/16	22/12/16	3362
Horn Antenna	ETS-Lindgren	3117	21/12/16	22/12/16	00140394
Horn Antenna	A.H.Systems Inc.	SAS-574	22/06/24	23/06/24	155
Horn Antenna	MI Wave	RX ANT-5 261U+410U	22/06/24	23/06/24	108
Horn Antenna	MI Wave	RX ANT-7 261E	22/06/24	23/06/24	112
Horn Antenna	MI Wave	RX ANT-8 261F	22/06/24	23/06/24	114
Horn Antenna	MI Wave	RX ANT-9 261G	22/06/24	23/06/24	116
PreAmplifier	Agilent Technologies	8449B	22/06/24	23/06/24	3008A02108
PreAmplifier	Agilent Technologies	8447D	21/12/16	22/12/16	2944A07774
PreAmplifier	tsj	MLA-1840-J02-45	22/06/24	23/06/24	16966-10728
PreAmplifier	Norden Millimeter Inc.	NA4060G50N8P12	21/02/18	23/02/18	1003
PreAmplifier	Norden Millimeter Inc.	NN6090G40N5P-2	21/02/18	23/02/18	1001
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	22/06/24	23/06/24	7
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	22/06/24	23/06/24	2
High Pass Filter	Wainwright Instruments	WHKX6-6320-8000-26500-40CC	22/06/24	23/06/24	2
Harmonic mixers	Rohde Schwarz	FS-Z90	22/08/04	23/08/04	101714
Harmonic mixers	Rohde Schwarz	FS-Z140	22/08/04	23/08/04	101009
Harmonic mixers	Rohde Schwarz	FS-Z220	21/10/07	23/10/07	101012
DC Power Supply	SM techno	SDP30-5D	22/06/24	23/06/24	305DMG305
Cable	HUBER+SUHNER	SUCOFLEX100	22/01/04	23/01/04	M-01
Cable	HUBER+SUHNER	SUCOFLEX100	22/01/04	23/01/04	M-02
Cable	JUNFLON	MWX241/B	22/01/04	23/01/04	M-03
Cable	JUNFLON	MWX221	22/01/04	23/01/04	M-04
Cable	JUNFLON	MWX221	22/01/04	23/01/04	M-05
Cable	JUNFLON	J12J101757-00	22/01/04	23/01/04	M-07
Cable	HUBER+SUHNER	SUCOFLEX104	22/01/04	23/01/04	M-08
Cable	HUBER+SUHNER	SUCOFLEX106	22/01/04	23/01/04	M-09
Cable	JUNFLON	MWX315	22/06/08	23/06/08	M-10
Cable	Junkosha	MWX241	22/01/04	23/01/04	mmW-1
Cable	Junkosha	MWX241	22/01/04	23/01/04	mmW-4
Cable	Junkosha	MWX261	22/01/04	23/01/04	mmW-6
Cable	HUBER+SUHNER	SUCOFLEX 104	22/01/04	23/01/04	mmW-8
Cable	HUBER+SUHNER	SUCOFLEX 104	22/01/04	23/01/04	mmW-9
Cable	SAGE MILLIMETER Inc	SCW-1M1M024-F1	22/01/04	23/01/04	mmW-10
Test Software	tsj	Radiated Emission Measurement	NA	NA	Version 2.00.0177

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.
Note2: The cable is not a regular calibration item, so it has been calibrated by Dt&C itself.

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2. Test Methodology

The measurement procedures described in the ANSI C63.10-2013 was used in measurement of the EUT.

2.1. EUT configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT exercise

The EUT was operated in the test mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.209, 15.249 and 15.255 under the FCC Rules Part 15 Subpart C.

2.3. General test procedures

Radiated Emissions

The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axes.

2.4. Description of test modes

The EUT configured for simultaneous transmission in the following mode of operation;

-	Technology	Mode	TX Frequency
Transmitting Configuration	Bluetooth LE	2 Mbps	2 440 MHz
	60 GHz Radar	-	60.5 GHz

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3. Summary of Test Results

FCC Part	Test Description	Limit	Test Condition	Status Note 1
15.247(d) 15.205 15.209	Unwanted Emissions(Radiated)	Part 15.209 limits	Radiated	C Note 2
15.255(d) 15.209	Unwanted Emissions	Below 40GHz < Part 15.209 limits 40 ~ 200GHz < 90 pW/cm^2		C Note 2

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: This test was only performed the worst points for each band of model 2A8FDVPR100

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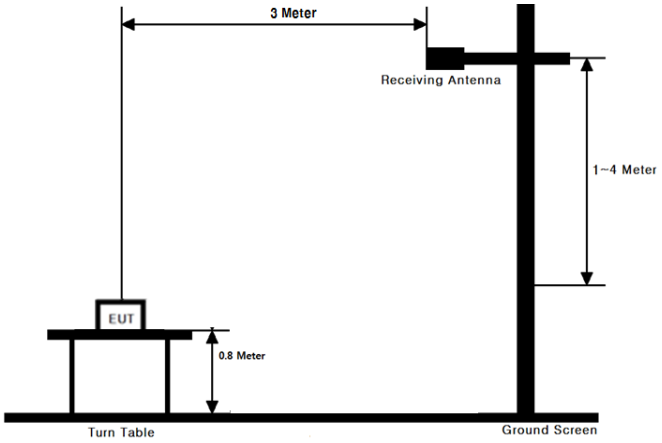
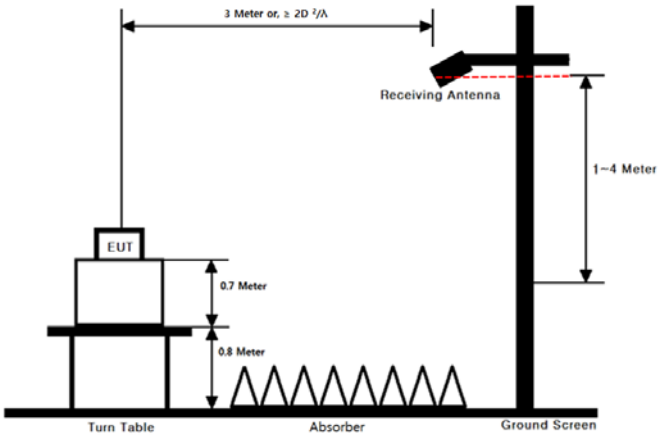
4. Unwanted Emissions (Radiated)

▣ Test Configuration

Below 1GHz	Above 1GHz
	

▣ Test Procedure

ANSI C63.10-2013 – Section 9.12, 9.13

The following procedure was used for measurement of the radiated spurious emissions.

1) The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements at above 1 GHz, the table height is 1.5 m

2) The table was rotated 360 degrees to determine the position of the highest radiation.

3) During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 0.5 ~ 3 meter away from the interference-receiving antenna.

4) For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.

5) The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

6) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.

7) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

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- Spectrum analyzer settings:

1. Frequency Range: Below 1 GHz
RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

2. Frequency Range: 1 ~ 40 GHz
Peak Measurement
RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

Average Measurement
RBW = 1 MHz, VBW ≥ 1/T, Detector = Peak, Sweep Time = Auto, Trace Mode = Max Hold until the trace stabilizes

Note: Unwanted emissions from the Bluetooth LE was measured by setting the spectrum analyzer as below:
RBW = 1 MHz, VBW = 3 MHz, Detector = RMS(Number of points ≥ 2 x Span / RBW), Averaging type = power (i.e., RMS), Sweep time = Auto, Trace mode = Perform a trace average of at least 100 traces.
A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used, then the applicable correction factor is 10 log(1 / D), where D is the duty cycle.
2) If linear voltage averaging mode was used, then the applicable correction factor is 20 log(1 / D), where D is the duty cycle.
3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

Mode	T_{on} (ms)	T_{on}+ T_{off} (ms)	D = T_{on} / (T_{on+off})	DCCF = 10 log(1 / D) (dB)
Bluetooth LE (2 Mbps)	0.207	0.624	0.331 7	4.79

3. Frequency Range: Above 40 GHz
RBW = 1 MHz, VBW = 1 or 3 MHz, Detector = Peak or average, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

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▣ Test Results: Comply

▪ **Note.**

1. The radiated emissions above 9 KHz were investigated up to 40 GHz. And no other spurious and harmonic emissions were found below listed frequencies.
2. Information of Distance Correction Factor
   For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.
   In this case, the distance factor is applied to the result.
   - Calculation of distance correction factor
   At frequencies below 30 MHz = 40 log(tested distance / specified distance)
   At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)
   When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + TF+ DCCF + DCF / TF = AF + CL + HL + AL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, HL = High pass filter Loss, AL = Attenuator Loss, DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

Frequency Range : 9 KHz ~ 40 GHz

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
32.91	V	X	PK	40.50	-9.50	N/A	N/A	31.00	40.00	9.00
71.71	H	X	PK	41.30	-10.50	N/A	N/A	30.80	40.00	9.20
83.35	H	X	PK	45.30	-12.30	N/A	N/A	33.00	40.00	7.00
800.17	H	X	PK	30.70	5.60	N/A	N/A	36.30	46.00	9.70
7318.33	H	X	PK	45.96	10.68	N/A	N/A	56.64	74.00	17.36
7318.67	H	X	AV	35.53	10.68	4.79	N/A	51.00	54.00	3.00

Worst-case plot **X axis & Hor**

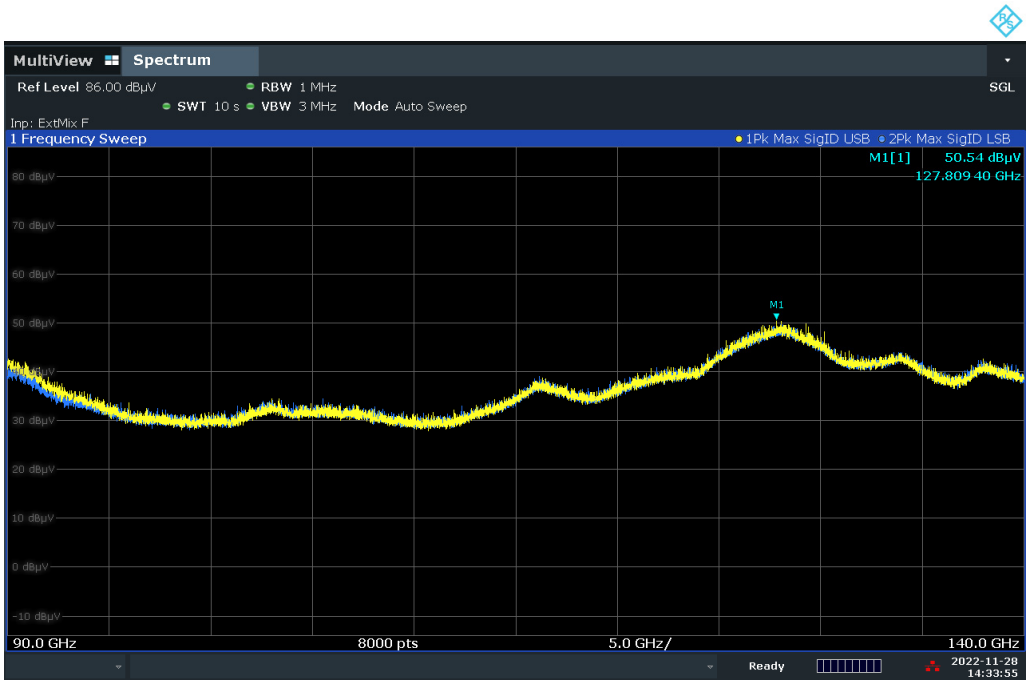
▪ **Note.**

1. The radiated emissions were investigated up to 200GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Sample Calculation.
   E(dBuV/m) = Measured level (dBuV) + 107 + TF(dB/m)
   where, E=field strength / TF(Total factor) = Antenna Factor(dB/m) + Cable Loss(dB/m) – Amplifier Gain(dB)
   EIRP(dBm) = E(dBuV/m) + 20log(D) - 104.7; where, D is measurement distance (in the far field region) in m.
   $PD = EIRP_{Linear} / 4\pi d^2$
   Where, PD = the power density at the distance specified by the limit, in W/m^2
   $EIRP_{Linear}$ = EIRP, in watts
   D = is the distance at which the power density limit is specified, in m
3. The mixer loss was applied to the measured level by SA correction factor.
4. * Noise floor

Frequency Range : 40 ~ 200 GHz

Measurement distance(m)	Frequency (MHz)	ANT Pol	Reading (dBuV)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
0.5	*127 809.40	H	50.54	48.39	98.92	-11.80	58.41	90.00
-	-	-	-	-	-	-	-	-

Worst-case plot (Noise floor) Y axis & Ver



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